FIG.1(a)

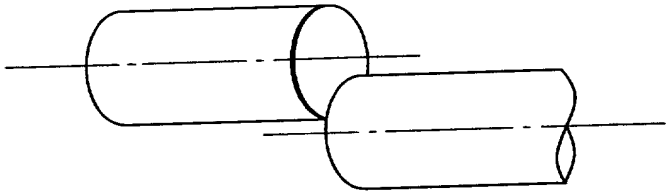


FIG.1(b)

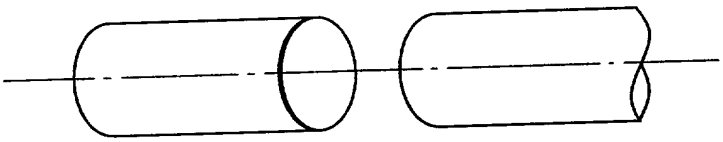


FIG.1(c)

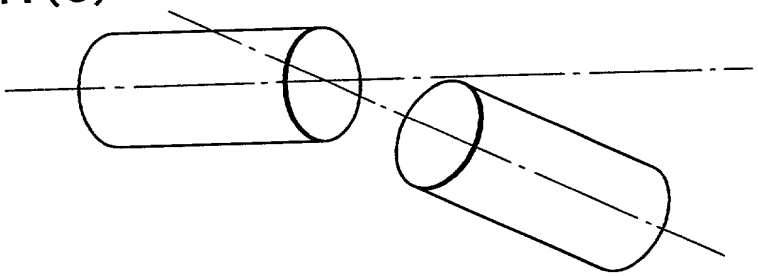


FIG.1(d)

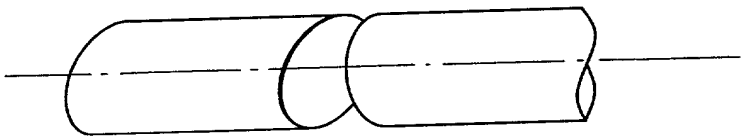


FIG.2

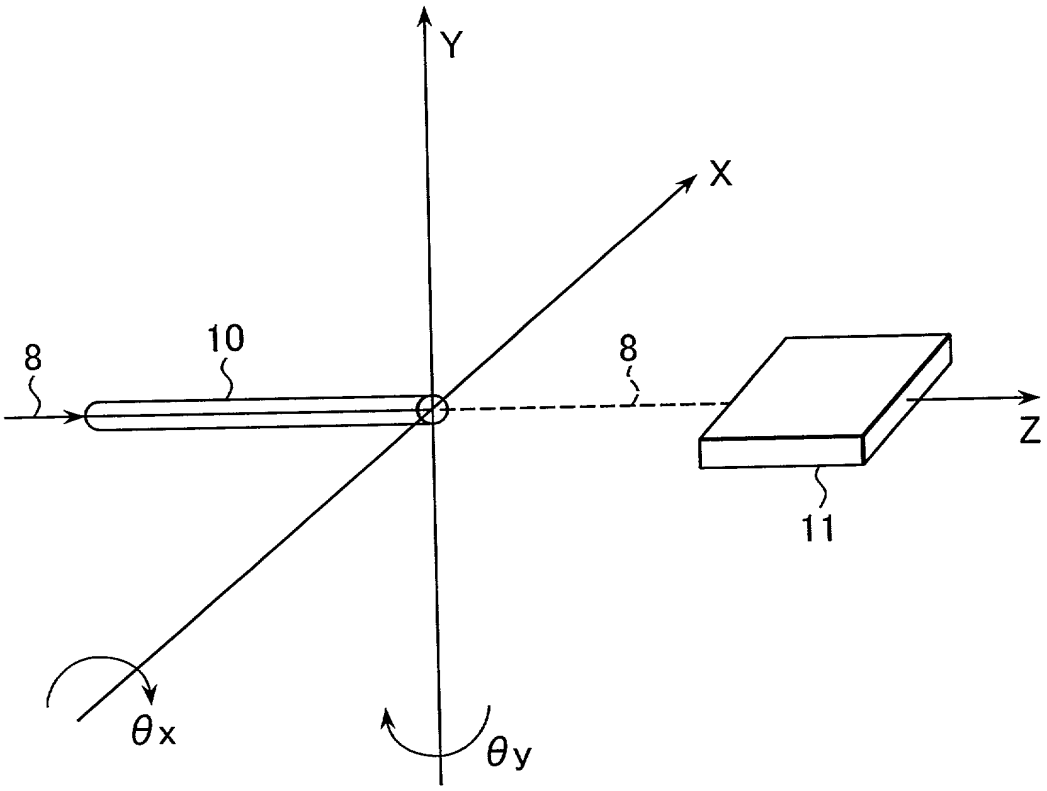

Y
X
Z
8
10
8
11
θx
θy

FIG.3

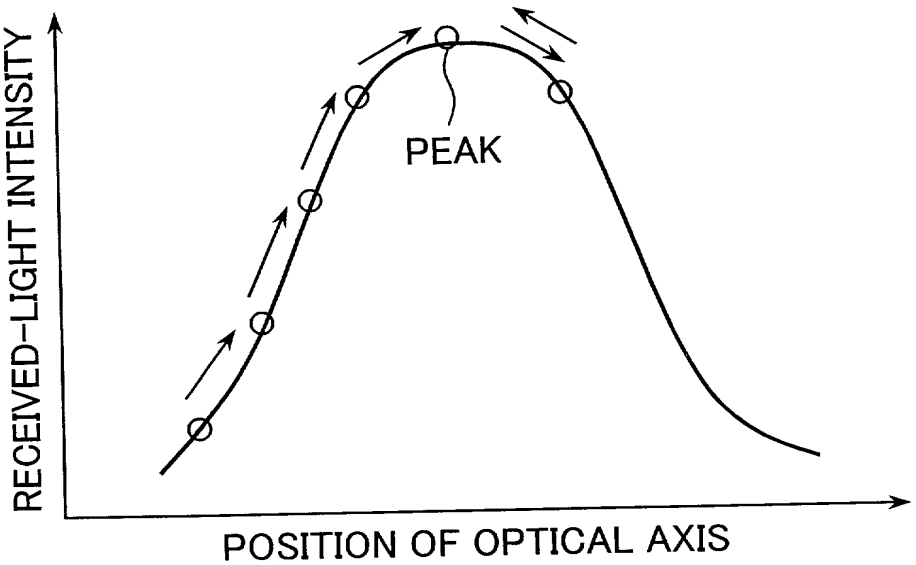

RECEIVED-LIGHT INTENSITY
PEAK
POSITION OF OPTICAL AXIS

FIG.4

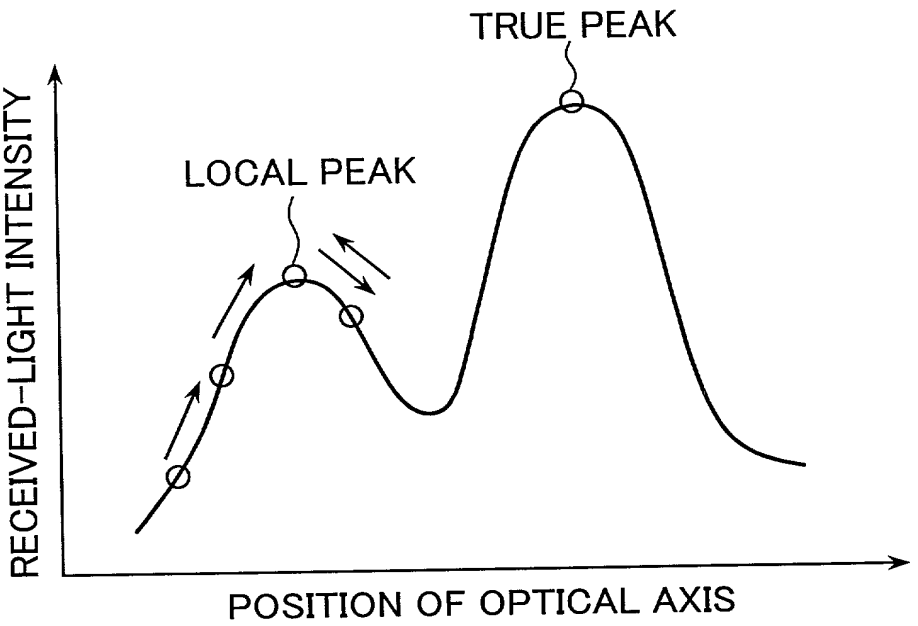

TRUE PEAK
LOCAL PEAK
RECEIVED-LIGHT INTENSITY
POSITION OF OPTICAL AXIS

FIG.5

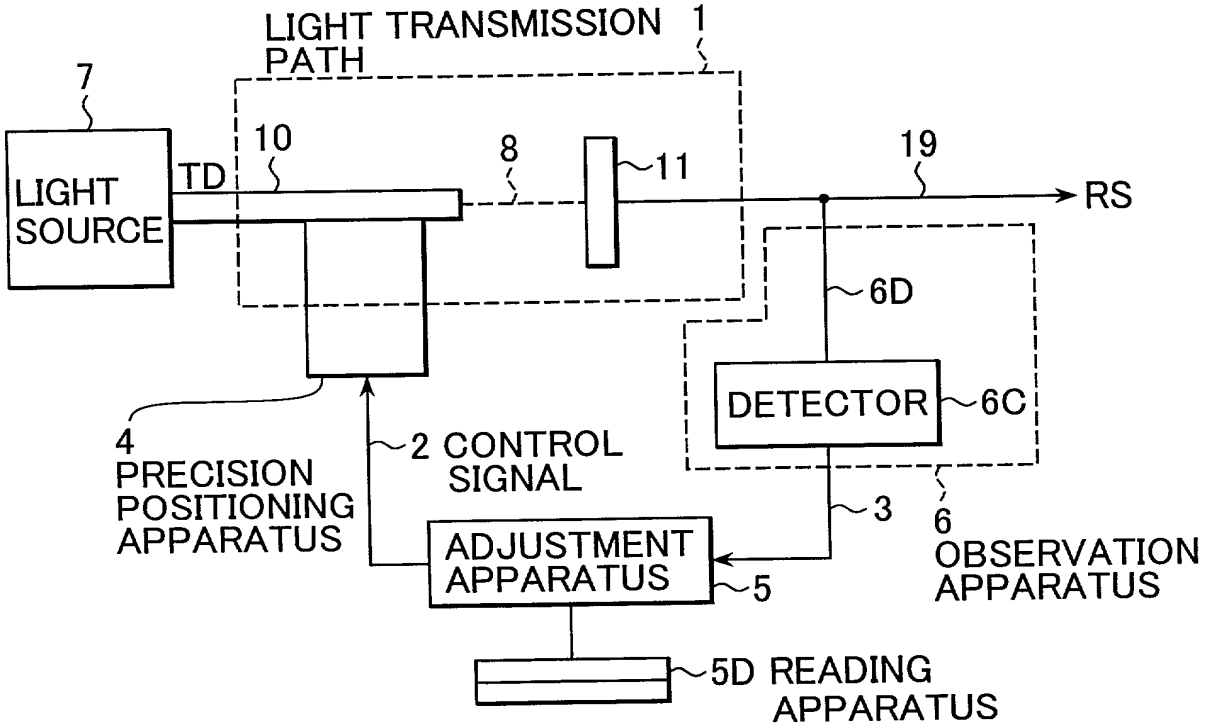

LIGHT TRANSMISSION PATH
1
7
LIGHT SOURCE
TD
10
8
11
19
RS
6D
DETECTOR
6C
4
PRECISION POSITIONING APPARATUS
2 CONTROL SIGNAL
3
6
OBSERVATION APPARATUS
ADJUSTMENT APPARATUS
5
5D READING APPARATUS

FIG.6

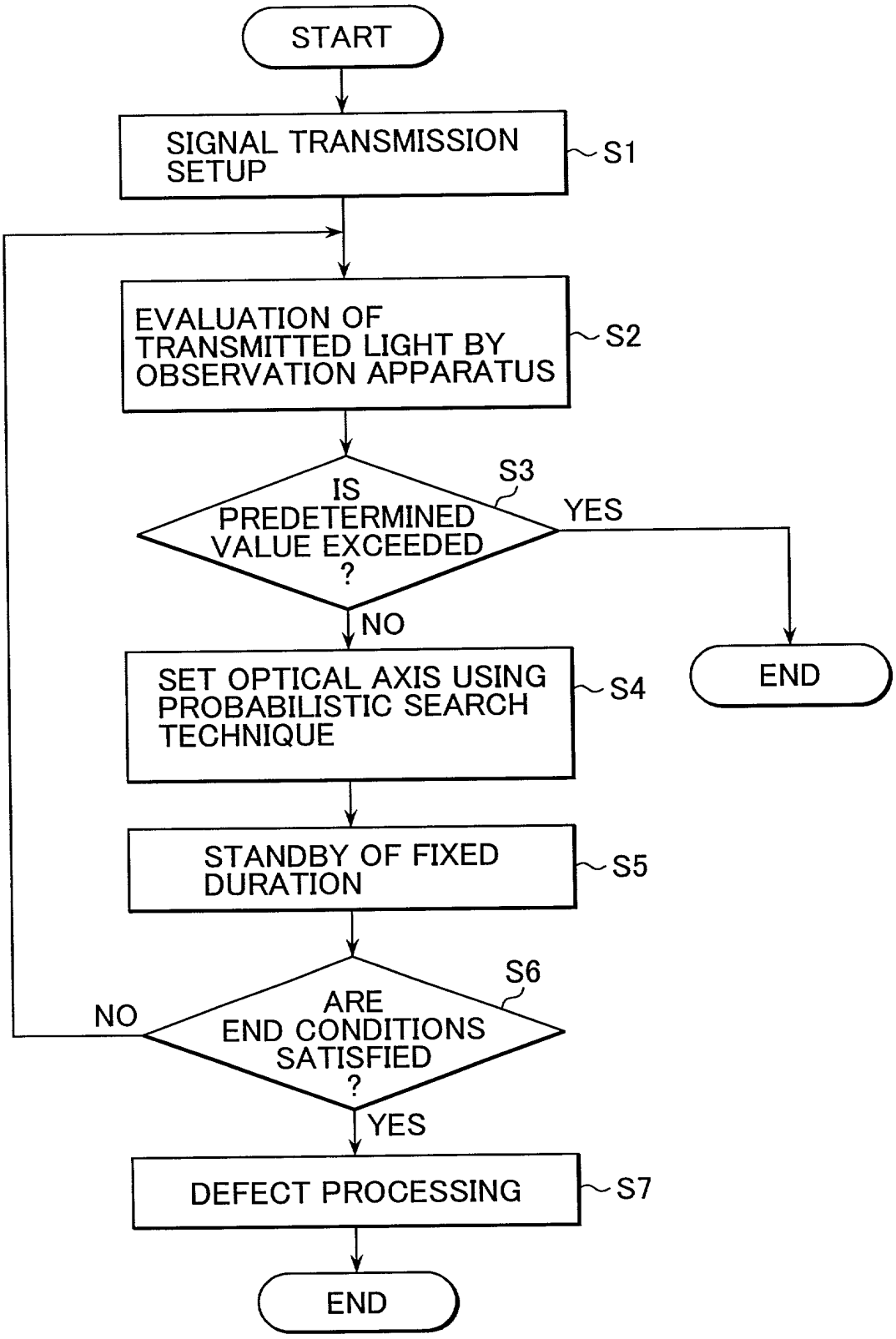

START
SIGNAL TRANSMISSION SETUP
S1
EVALUATION OF TRANSMITTED LIGHT BY OBSERVATION APPARATUS
S2
IS PREDETERMINED VALUE EXCEEDED ?
S3
YES
NO
END
SET OPTICAL AXIS USING PROBABILISTIC SEARCH TECHNIQUE
S4
STANDBY OF FIXED DURATION
S5
ARE END CONDITIONS SATISFIED ?
S6
NO
YES
DEFECT PROCESSING
S7
END

FIG.7

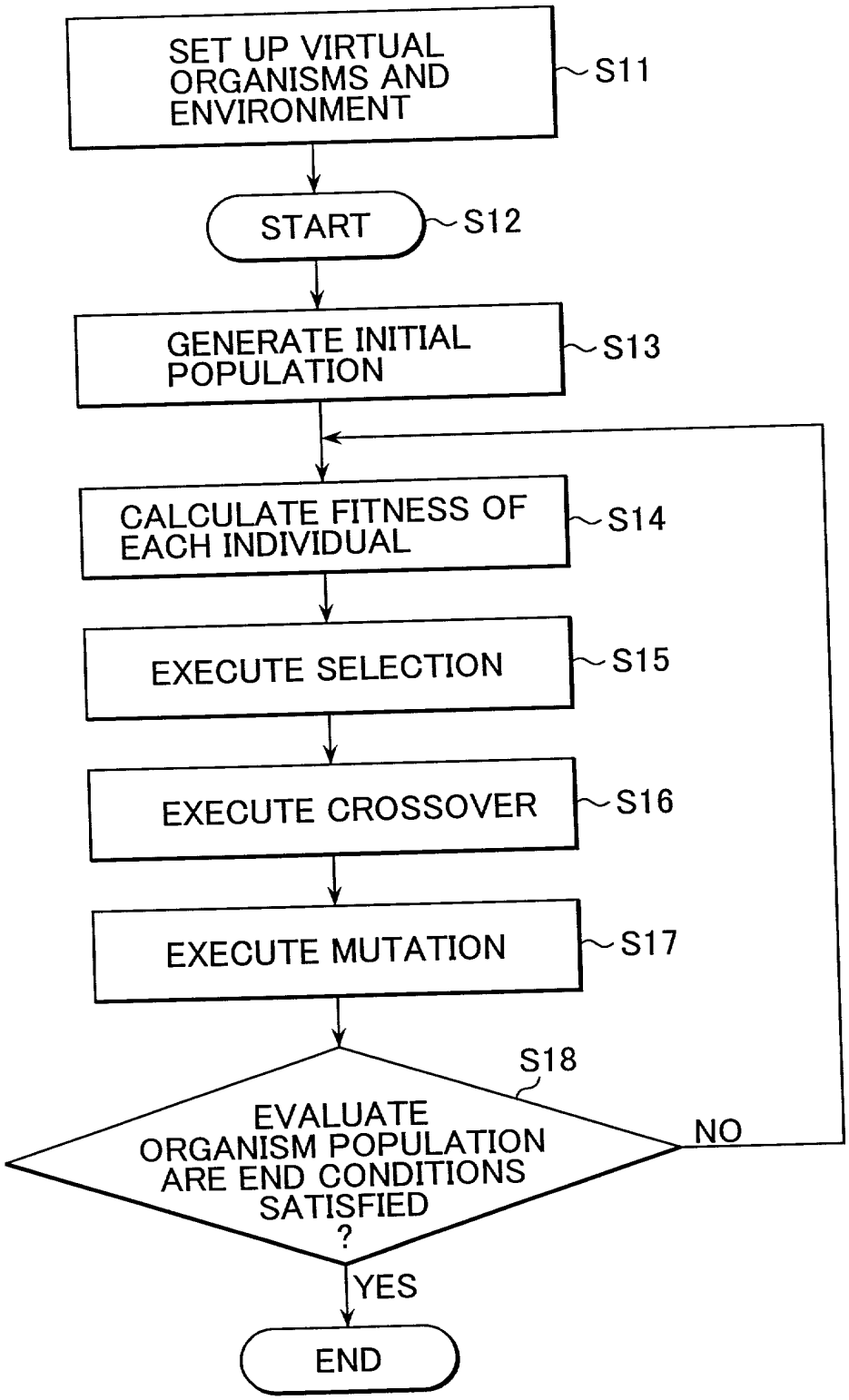

SET UP VIRTUAL ORGANISMS AND ENVIRONMENT
S11
START
S12
GENERATE INITIAL POPULATION
S13
CALCULATE FITNESS OF EACH INDIVIDUAL
S14
EXECUTE SELECTION
S15
EXECUTE CROSSOVER
S16
EXECUTE MUTATION
S17
S18
EVALUATE ORGANISM POPULATION ARE END CONDITIONS SATISFIED ?
NO
YES
END

FIG.8

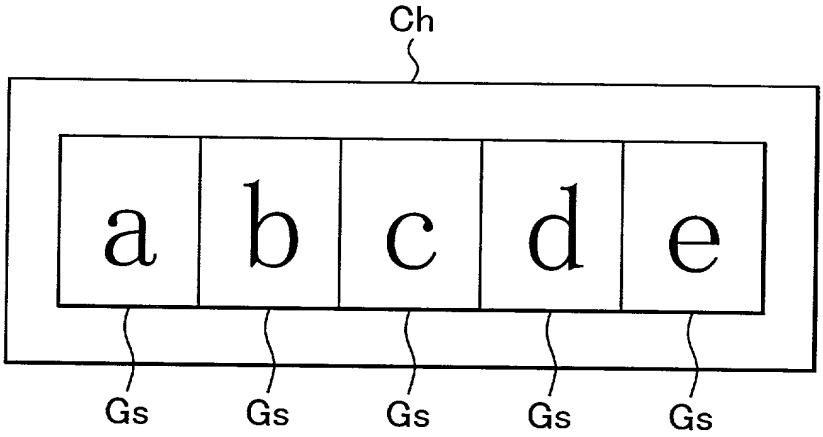

Ch
a
b
c
d
e
Gs
Gs
Gs
Gs
Gs

FIG.9

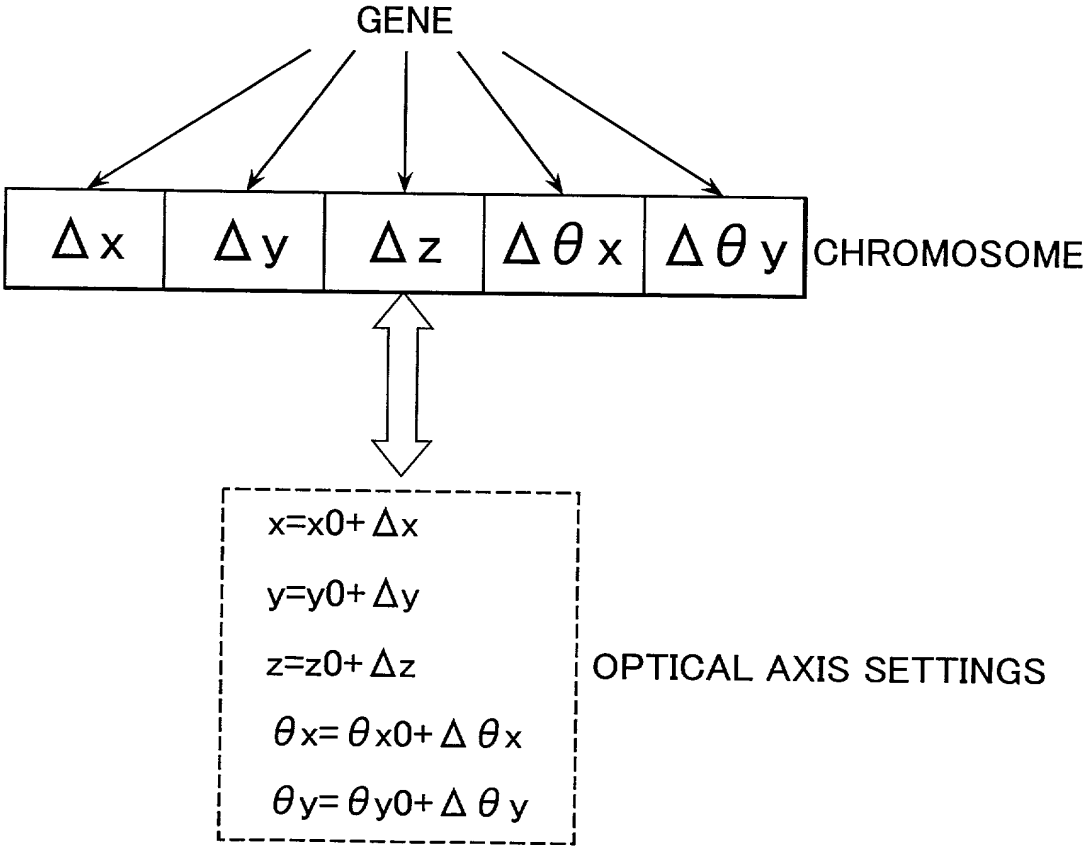

GENE
Δx
Δy
Δz
Δθx
Δθy
CHROMOSOME
x=x0+Δx
y=y0+Δy
z=z0+Δz
θx=θx0+Δθx
θy=θy0+Δθy
OPTICAL AXIS SETTINGS

FIG.10

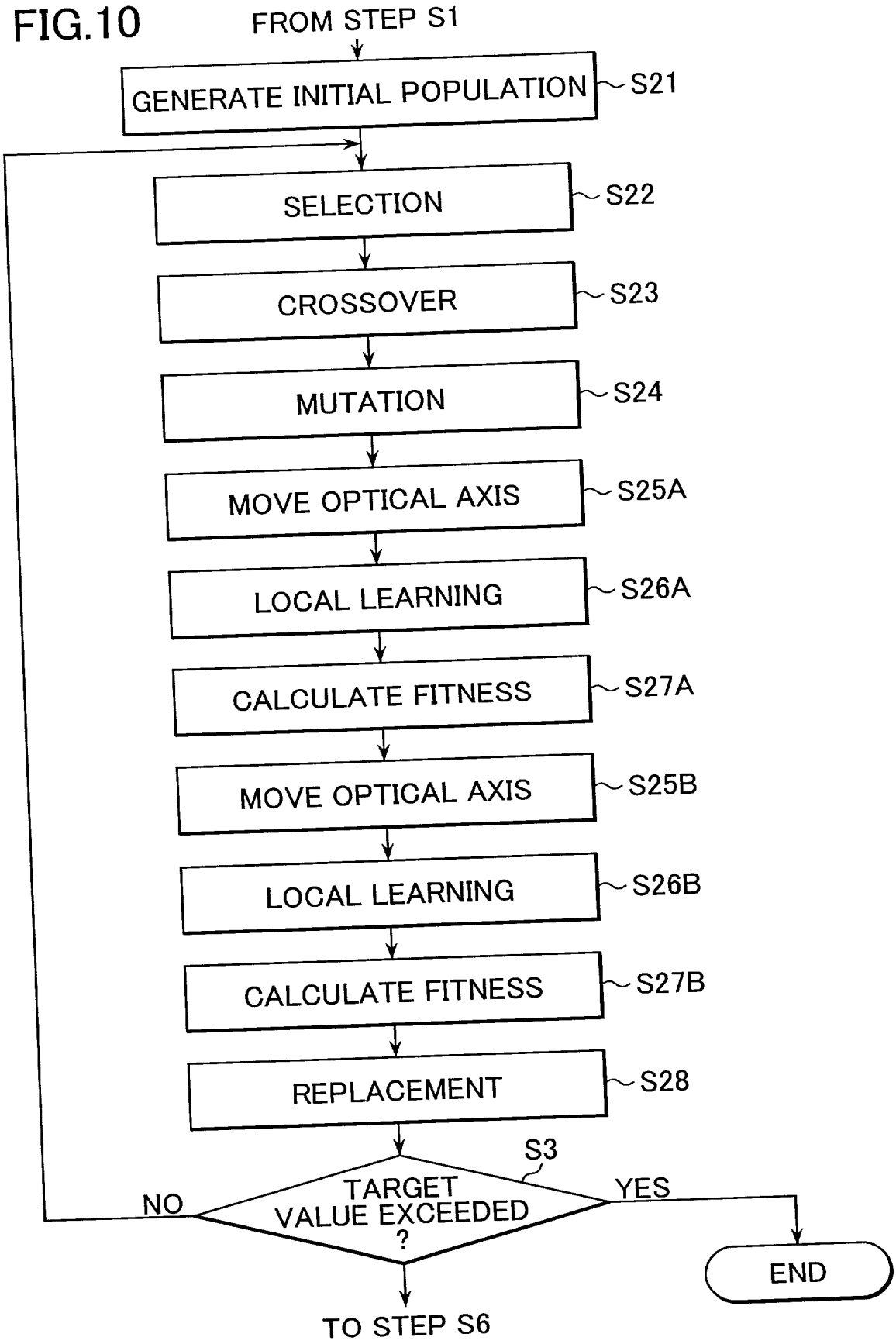

FROM STEP S1
GENERATE INITIAL POPULATION
S21
SELECTION
S22
CROSSOVER
S23
MUTATION
S24
MOVE OPTICAL AXIS
S25A
LOCAL LEARNING
S26A
CALCULATE FITNESS
S27A
MOVE OPTICAL AXIS
S25B
LOCAL LEARNING
S26B
CALCULATE FITNESS
S27B
REPLACEMENT
S28
S3
TARGET VALUE EXCEEDED ?
NO
YES
END
TO STEP S6

FIG.11

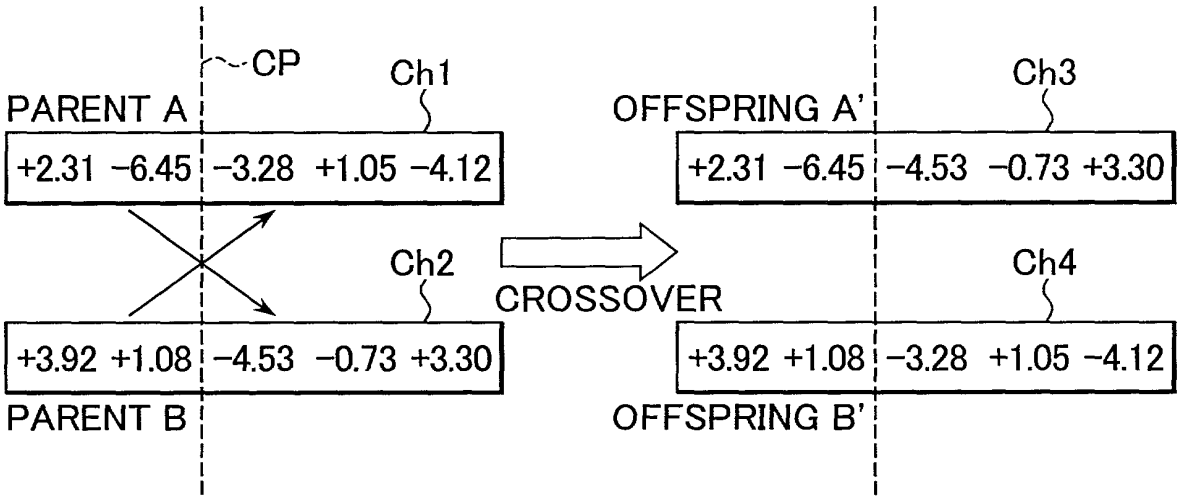

CP
Ch1
PARENT A
+2.31 −6.45 −3.28 +1.05 −4.12
Ch2
+3.92 +1.08 −4.53 −0.73 +3.30
PARENT B
CROSSOVER
Ch3
OFFSPRING A'
+2.31 −6.45 −4.53 −0.73 +3.30
Ch4
+3.92 +1.08 −3.28 +1.05 −4.12
OFFSPRING B'

FIG.12

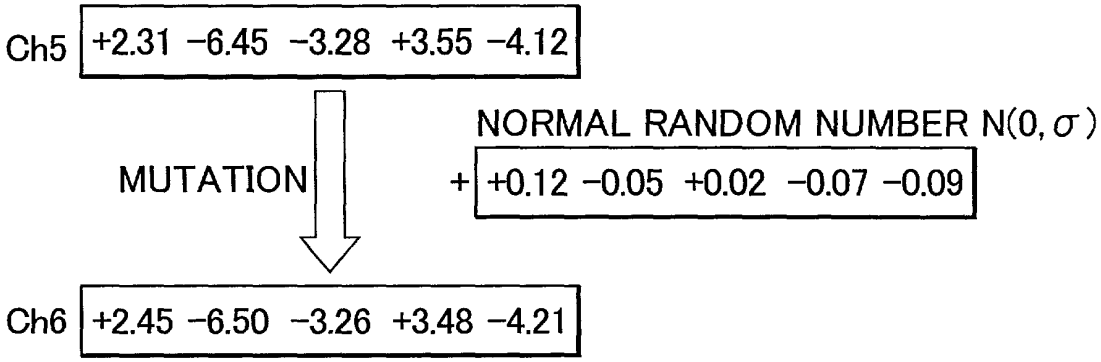

Ch5
+2.31 −6.45 −3.28 +3.55 −4.12
MUTATION
NORMAL RANDOM NUMBER N(0, σ)
+
+0.12 −0.05 +0.02 −0.07 −0.09
Ch6
+2.45 −6.50 −3.26 +3.48 −4.21

FIG.13

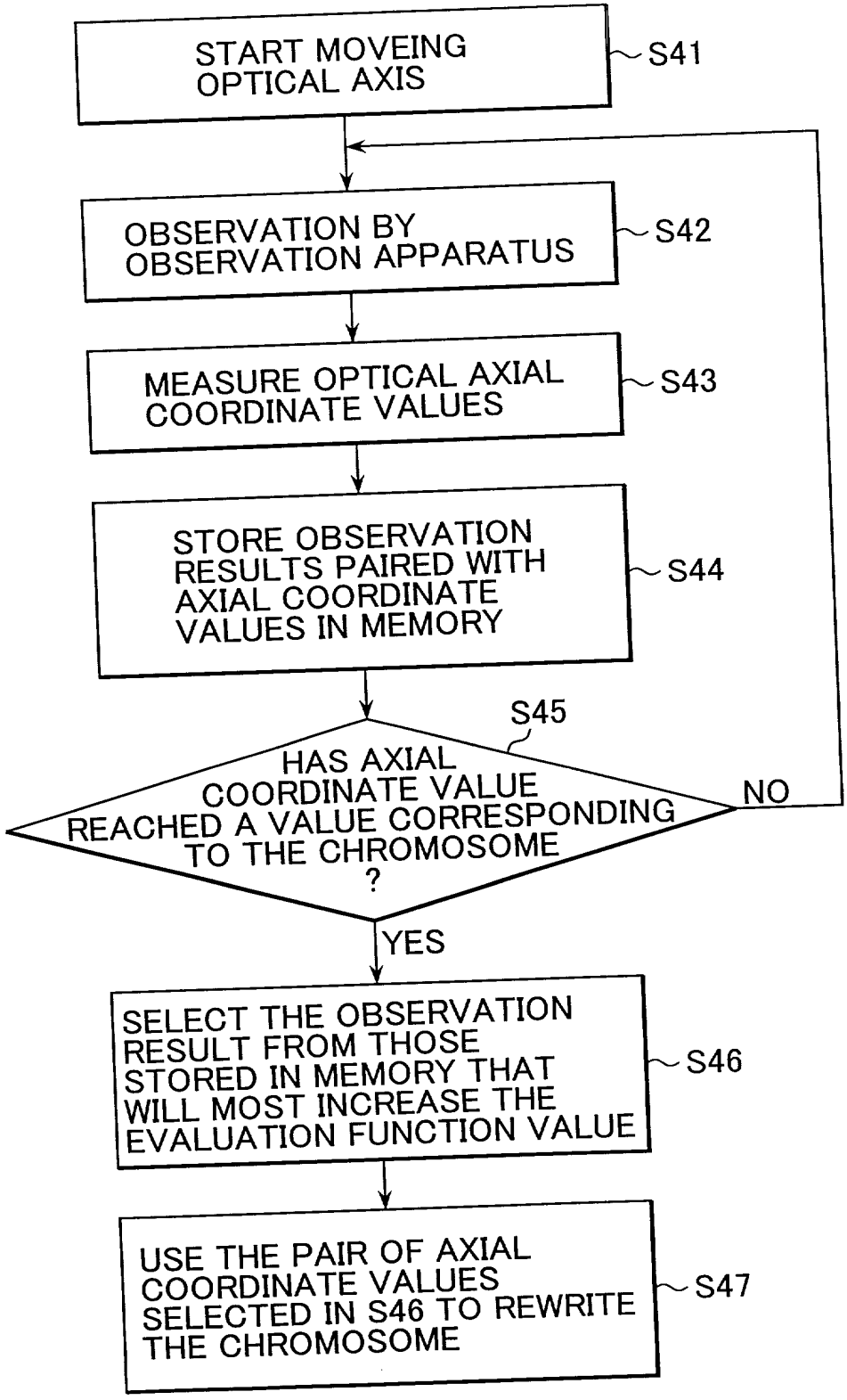

START MOVEING OPTICAL AXIS
S41
OBSERVATION BY OBSERVATION APPARATUS
S42
MEASURE OPTICAL AXIAL COORDINATE VALUES
S43
STORE OBSERVATION RESULTS PAIRED WITH AXIAL COORDINATE VALUES IN MEMORY
S44
S45
HAS AXIAL COORDINATE VALUE REACHED A VALUE CORRESPONDING TO THE CHROMOSOME ?
NO
YES
SELECT THE OBSERVATION RESULT FROM THOSE STORED IN MEMORY THAT WILL MOST INCREASE THE EVALUATION FUNCTION VALUE
S46
USE THE PAIR OF AXIAL COORDINATE VALUES SELECTED IN S46 TO REWRITE THE CHROMOSOME
S47

FIG.14

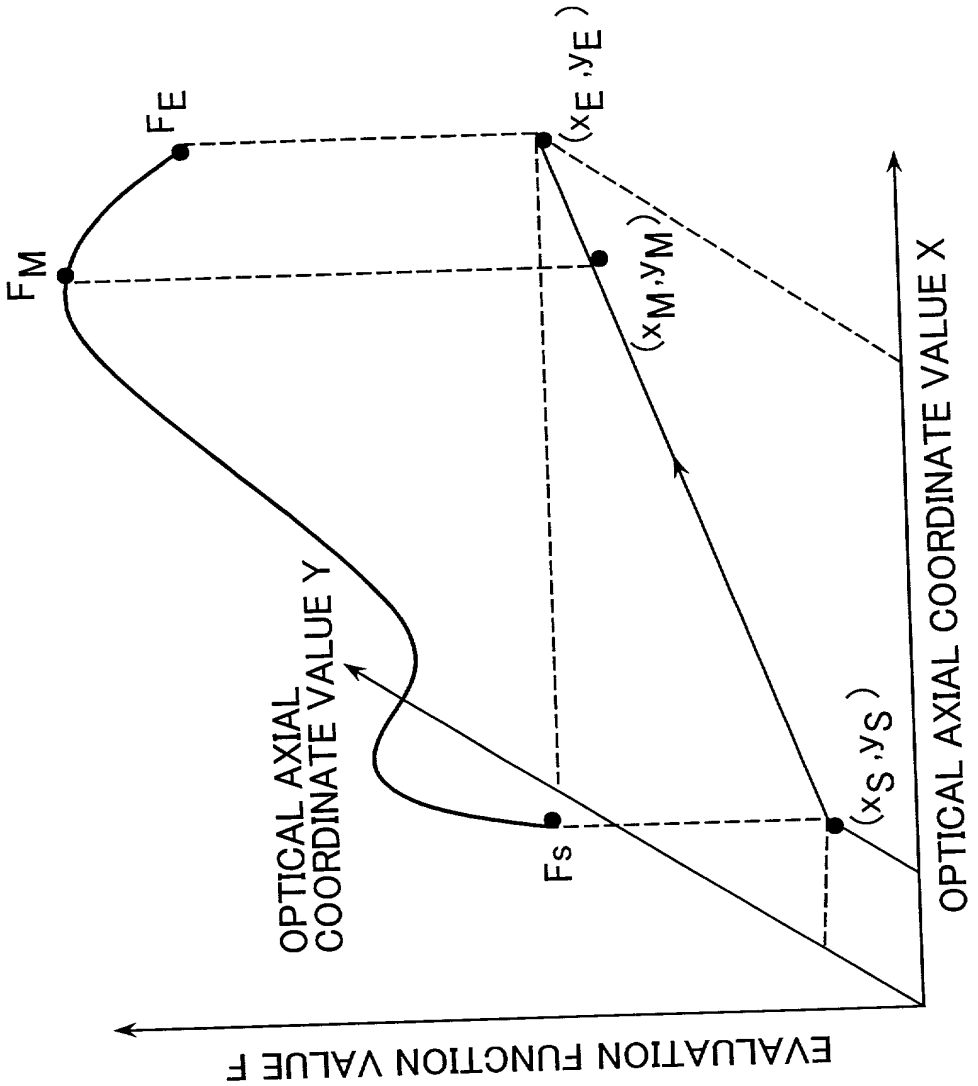

EVALUATION FUNCTION VALUE F
OPTICAL AXIAL COORDINATE VALUE X
OPTICAL AXIAL COORDINATE VALUE Y
FE
FM
FS
(xE,yE)
(xM,yM)
(xS,yS)

FIG.15

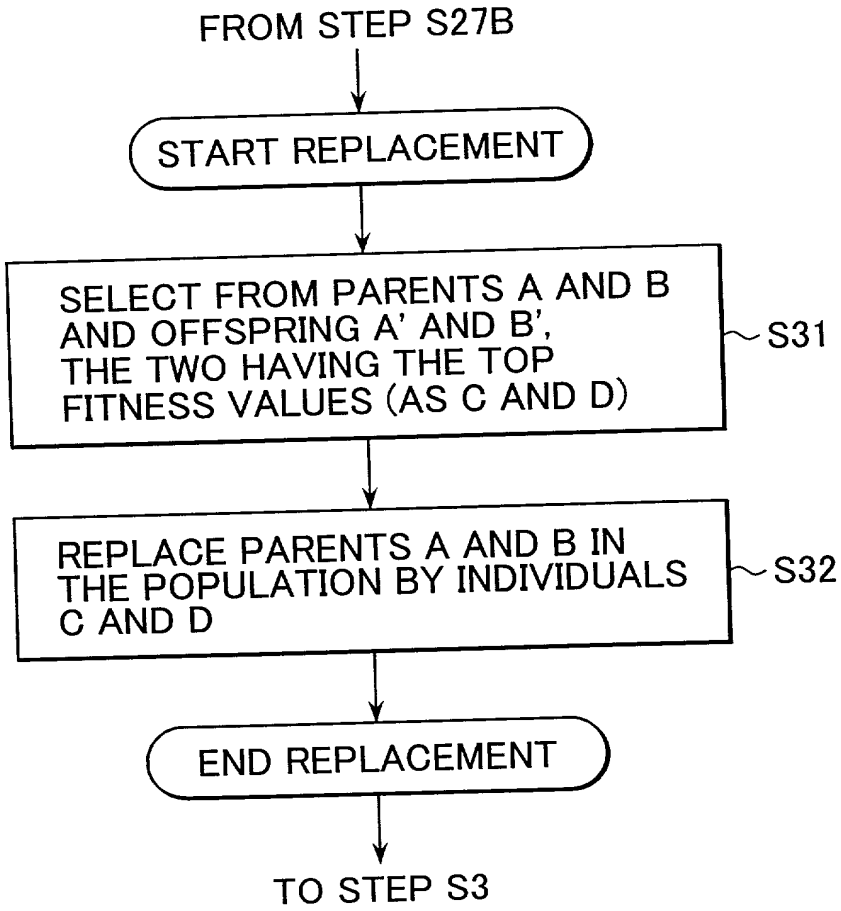

FROM STEP S27B
START REPLACEMENT
SELECT FROM PARENTS A AND B AND OFFSPRING A' AND B', THE TWO HAVING THE TOP FITNESS VALUES (AS C AND D)
S31
REPLACE PARENTS A AND B IN THE POPULATION BY INDIVIDUALS C AND D
S32
END REPLACEMENT
TO STEP S3

FIG.16

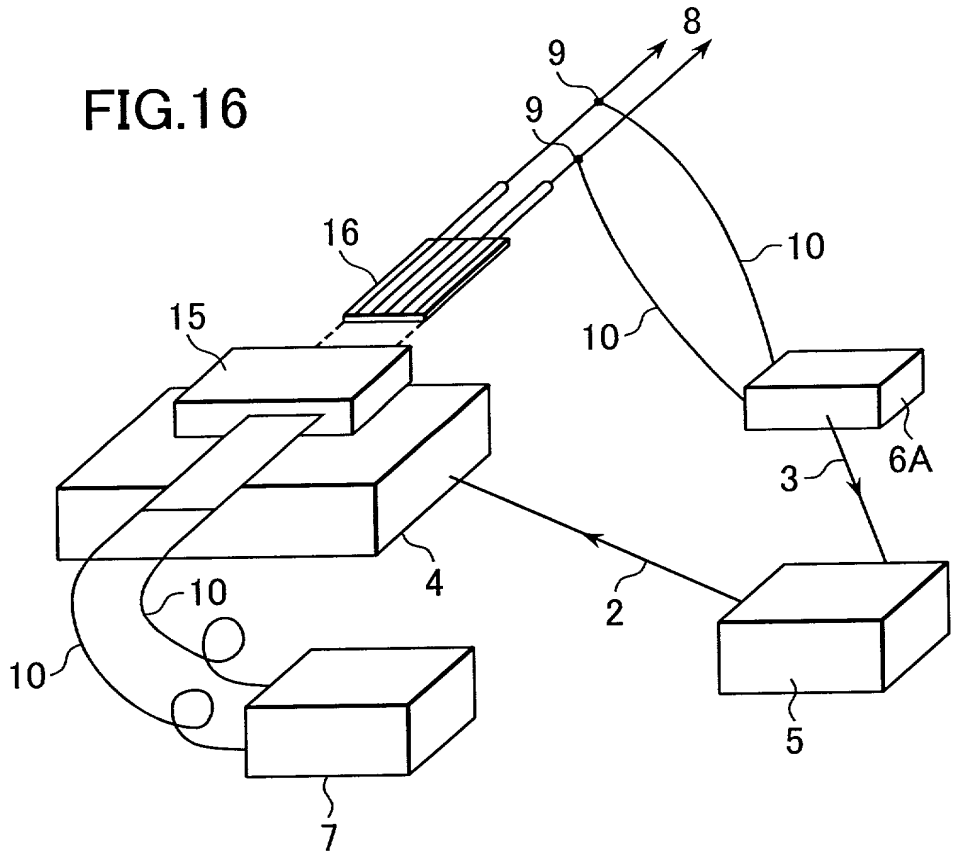


FIG.17

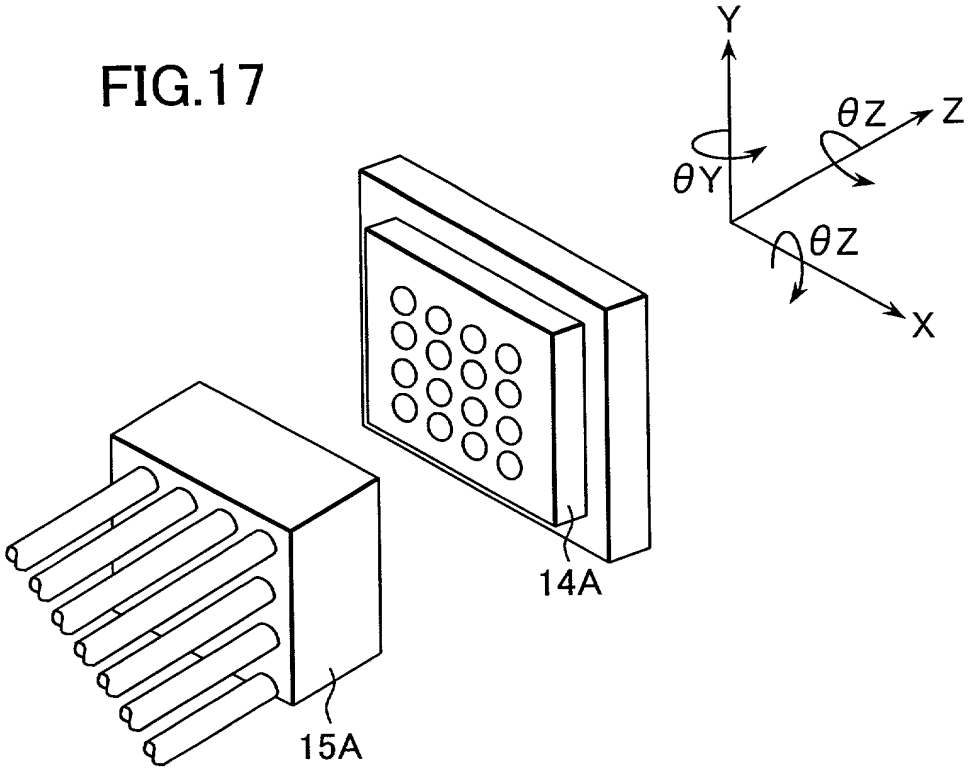


FIG.18

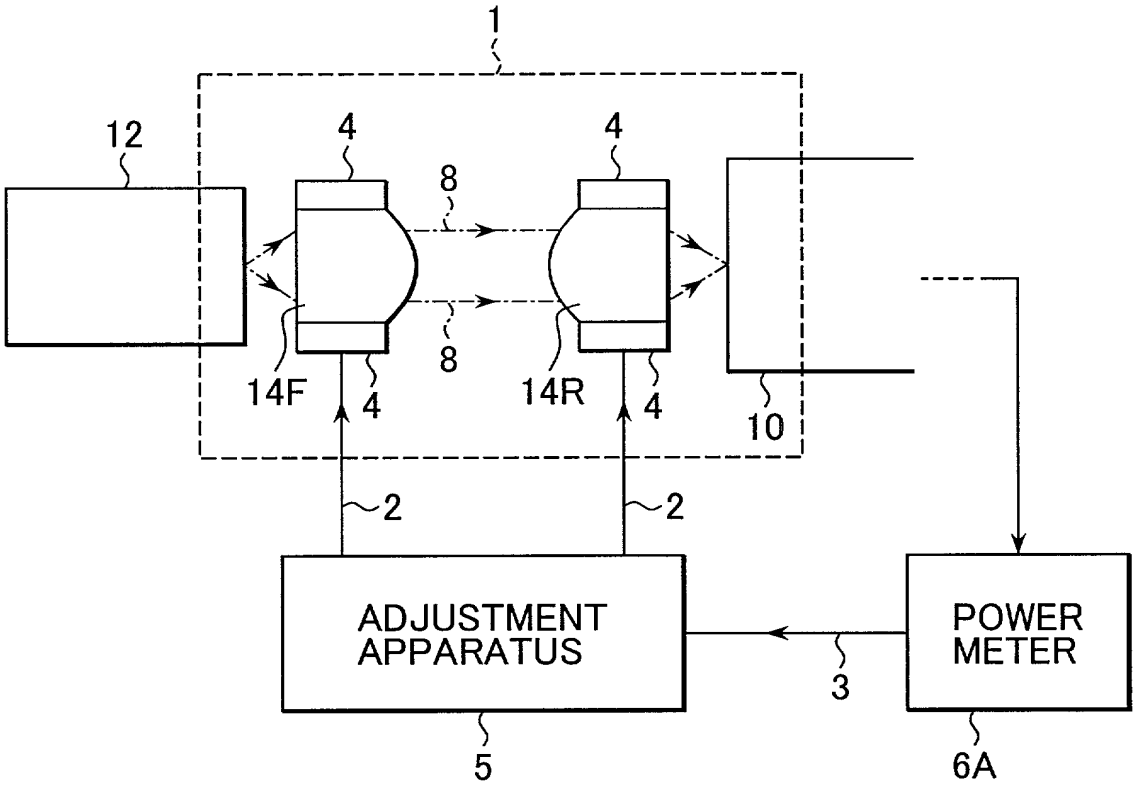

1
12
4
4
8
8
14F
14R
4
4
10
2
2
ADJUSTMENT APPARATUS
POWER METER
3
5
6A

FIG.19

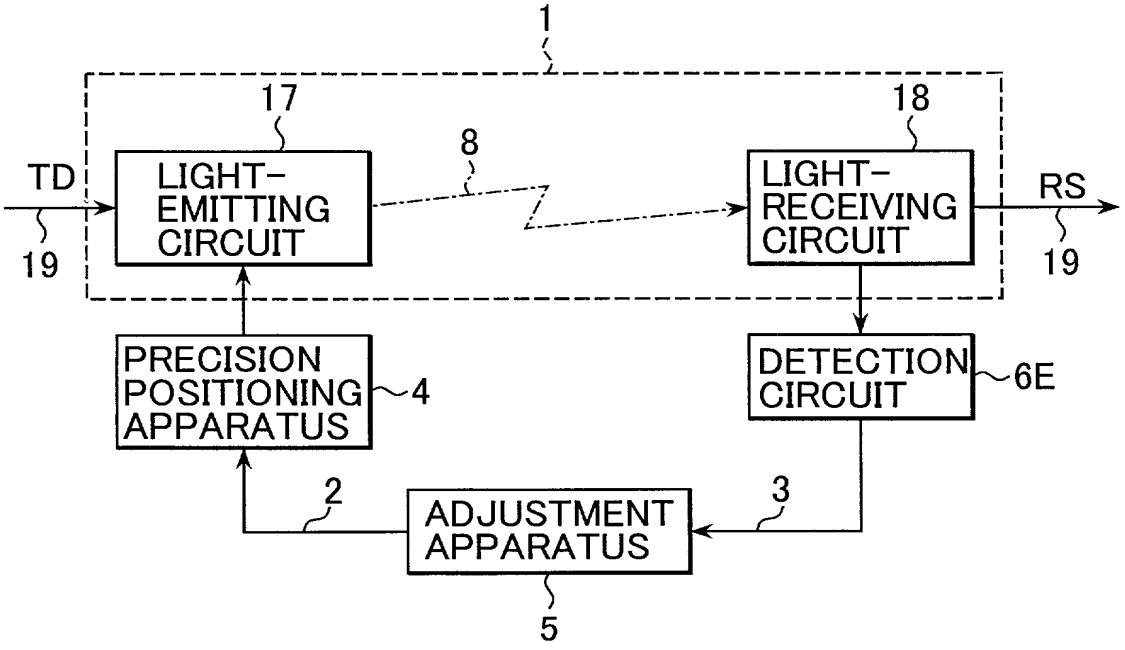

1
17
18
TD
LIGHT-EMITTING CIRCUIT
8
LIGHT-RECEIVING CIRCUIT
RS
19
19
PRECISION POSITIONING APPARATUS
4
DETECTION CIRCUIT
6E
2
ADJUSTMENT APPARATUS
3
5

FIG.20

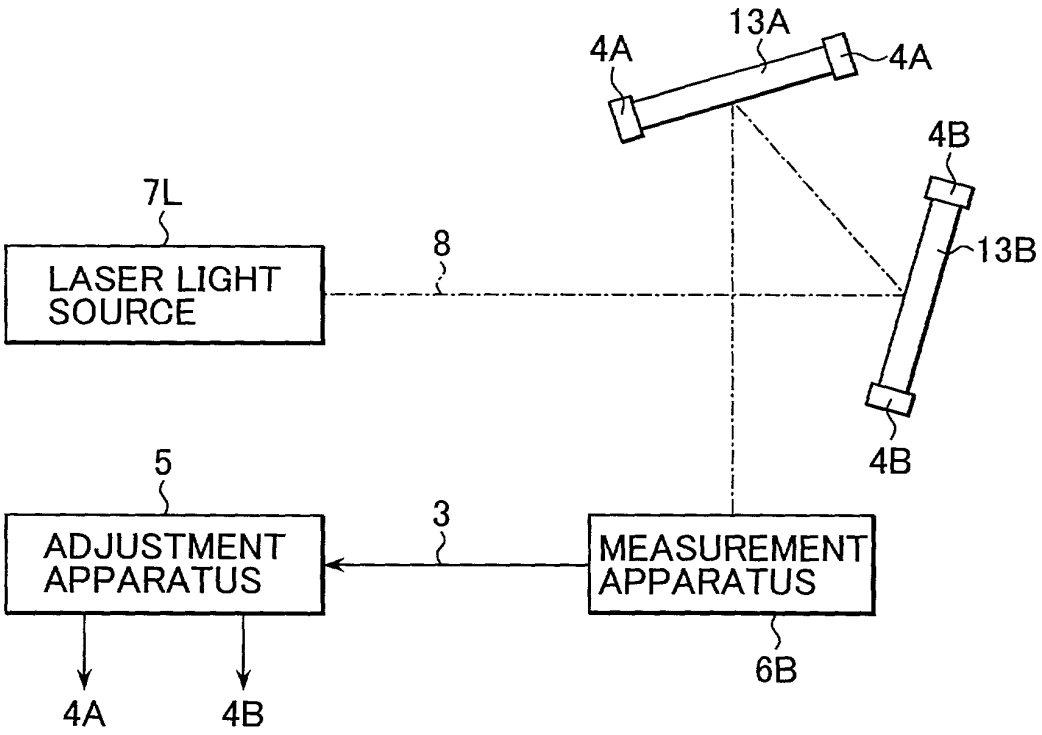
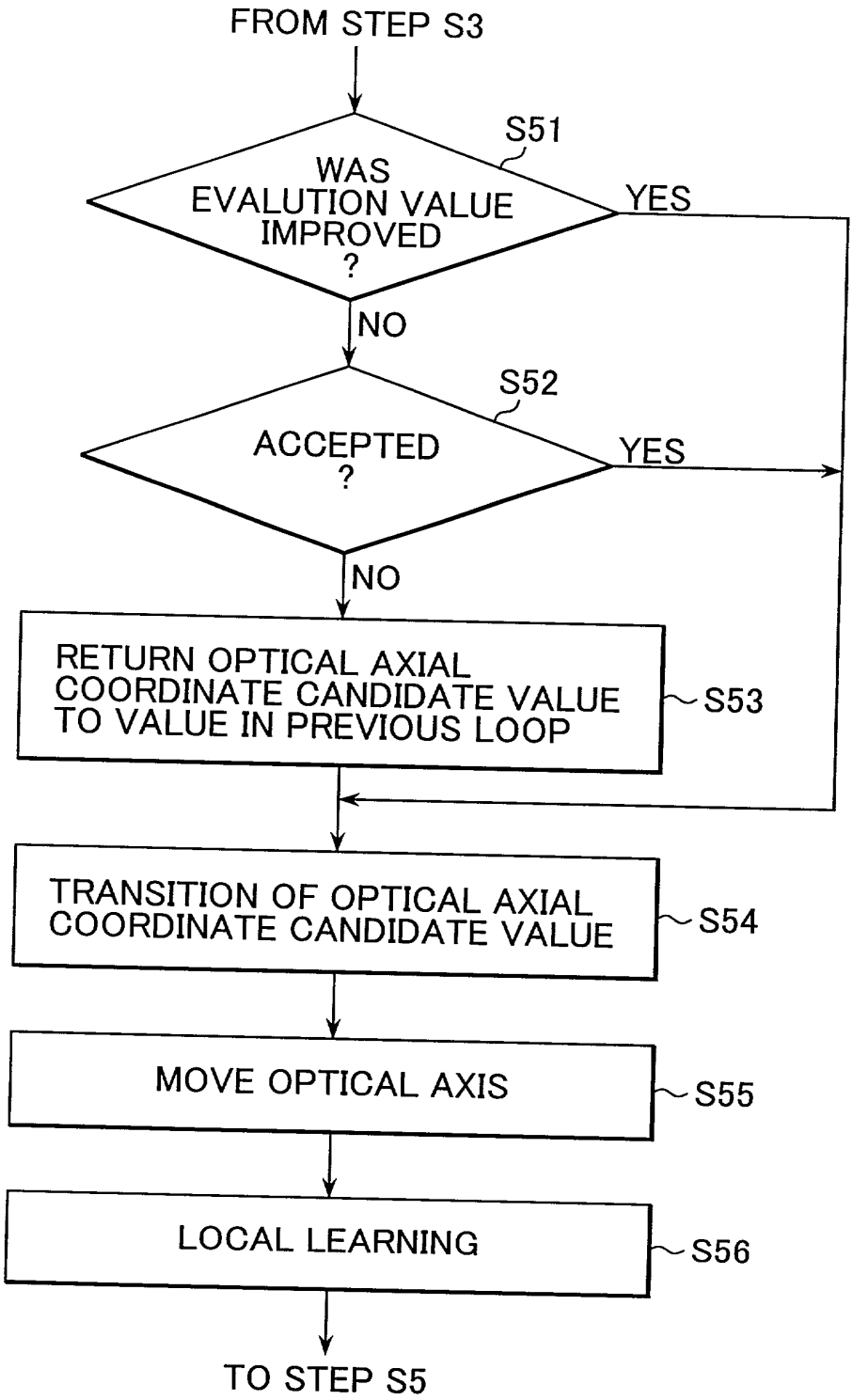

13A
4A
4A
4B
7L
8
LASER LIGHT SOURCE
13B
4B
5
3
ADJUSTMENT APPARATUS
MEASUREMENT APPARATUS
6B
4A
4B

FIG.21


FROM STEP S3
S51
WAS EVALUTION VALUE IMPROVED ?
YES
NO
S52
ACCEPTED ?
YES
NO
RETURN OPTICAL AXIAL COORDINATE CANDIDATE VALUE TO VALUE IN PREVIOUS LOOP
S53
TRANSITION OF OPTICAL AXIAL COORDINATE CANDIDATE VALUE
S54
MOVE OPTICAL AXIS
S55
LOCAL LEARNING
S56
TO STEP S5